CLAIMS

1. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input signal light;

an output detecting unit which detects an output level of said optical amplifier;

an output control unit which controls an output level of said optical amplifier according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination relating to a wavelength of said optical amplifier; and

a gain inclination control unit which controls a gain inclination of said optical amplifier according to a gain inclination detected by said gain inclination detecting unit.

2. The optical amplifier apparatus according to claim 1, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

3. The optical amplifier apparatus according to claim 1, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

4. The optical amplifier apparatus according to claim 1, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

5. The optical amplifier apparatus according to claim 1, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

6. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

an optical variable attenuator which attenuates an output signal light of said optical amplifier;

an output detecting unit which detects an output level at an output side of said optical variable attenuator;

an output control unit which controls the attenuation of an output signal light attenuated by said optical variable attenuator according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination relating to a wavelength of said optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting an output light of an excitation light source of said optical amplifier according to a gain inclination detected by said gain inclination detecting unit.

7. The optical amplifier apparatus according to claim 6, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

8. The optical amplifier apparatus according to claim 6, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

9. The optical amplifier apparatus according to claim 6, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

10. The optical amplifier apparatus according to claim 6, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

11. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

an optical variable attenuator which attenuates an output signal light of said optical amplifier;

an output detecting unit which detects an output level at an output side of said optical variable attenuator;

an output control unit which controls an output light of an excitation light source of said optical amplifier according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination relating to a wavelength of said optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting the attenuation of an output signal light attenuated by said optical variable attenuator according to a gain inclination detected by said gain inclination detecting unit.

12. The optical amplifier apparatus according to claim 11, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

13. The optical amplifier apparatus according to claim 11, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

14. The optical amplifier apparatus according to claim 11, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

15. The optical amplifier apparatus according to claim 11, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

16. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

a compensation light source which injects a compensation light that propagates in a forward direction of a propagation direction of an input signal light to said optical amplifier;

a wavelength selecting unit which interrupts a compensation light at an output side of said optical amplifier, and transmits only a signal light;

an output detecting unit which detects an output level of a signal light at an output side of said wavelength selecting unit;

an output control unit which controls an output light of said compensation light source according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting an output light of an excitation light source of said optical amplifier according to a gain inclination detected by said gain inclination detecting unit.

17. The optical amplifier apparatus according to claim 16, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

18. The optical amplifier apparatus according to claim 16, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

19. The optical amplifier apparatus according to claim 16, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

20. The optical amplifier apparatus according to claim 16, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical

signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

21. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

a compensation light source which injects a compensation light that propagates in a forward direction of a propagation direction of the input signal light to said optical amplifier;

a wavelength selecting unit which interrupts a compensation light at an output side of said optical amplifier, and transmits only a signal light;

an output detecting unit which detects an output level of a signal light at an output side of said wavelength selecting unit;

an output control unit which controls an output light of an excitation light source of said optical amplifier according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said optical amplifier; and

a gain inclination control unit which controls a gain

inclination by adjusting an output light of said compensation light source according to a gain inclination detected by said gain inclination detecting unit.

22. The optical amplifier apparatus according to claim 21, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

23. The optical amplifier apparatus according to claim 21, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

24. The optical amplifier apparatus according to claim 21, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

25. The optical amplifier apparatus according to claim 21, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

26. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

a compensation light source which injects a compensation light that propagates in a forward direction of a propagation direction of the input signal light to said optical amplifier;

an optical variable attenuator which attenuates an output signal light of said optical amplifier;

a wavelength selecting unit which interrupts a compensation light at an output side of said optical variable attenuator, and transmits only a signal light;

an output detecting unit which detects an output level of a signal light at an output side of said wavelength selecting unit;

an output control unit which controls the attenuation

of an output signal light of said optical variable attenuator according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting an output light of said compensation light source according to a gain inclination detected by said gain inclination detecting unit.

27. The optical amplifier apparatus according to claim 26, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

28. The optical amplifier apparatus according to claim 26, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

29. The optical amplifier apparatus according to claim 26, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually

different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

30. The optical amplifier apparatus according to claim 26, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

31. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

a compensation light source which injects a compensation light that propagates in a forward direction of a propagation direction of the input signal light to said optical amplifier;

an optical variable attenuator which attenuates an output signal light of said optical amplifier;

a wavelength selecting unit which interrupts a

compensation light at an output side of said optical variable attenuator, and transmits only a signal light;

an output detecting unit which detects an output level of a signal light at an output side of said wavelength selecting unit;

an output control unit which controls an output light of said compensation light source according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting the attenuation of an output signal light attenuated by said optical variable attenuator according to a gain inclination detected by said gain inclination detecting unit.

32. The optical amplifier apparatus according to claim 31, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

33. The optical amplifier apparatus according to claim 31, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain

inclination from optical signal levels of three or more waves.

34. The optical amplifier apparatus according to claim 31, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

35. The optical amplifier apparatus according to claim 31, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

36. An optical amplifier apparatus comprising:

a first optical amplifier which amplifies an input wavelength-multiplexed signal light;

an optical variable attenuator which attenuates an

output signal light of said first optical amplifier;

a second optical amplifier which amplifies an output signal light of said optical variable attenuator;

an output detecting unit which detects an output level at an output side of said second optical amplifier;

an output control unit which controls the attenuation of an output signal light attenuated by said optical variable attenuator according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said second optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting output lights of excitation light sources of said first optical amplifier and said second optical amplifier according to a gain inclination detected by said gain inclination detecting unit.

37. The optical amplifier apparatus according to claim 36, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

38. The optical amplifier apparatus according to claim 36, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

39. The optical amplifier apparatus according to claim 36, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

40. The optical amplifier apparatus according to claim 36, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

41. An optical amplifier apparatus comprising:

a first optical amplifier which amplifies an input wavelength-multiplexed signal light;

an optical variable attenuator which attenuates an output signal light of said first optical amplifier;

a second optical amplifier which amplifies an output signal light of said optical variable attenuator;

an output detecting unit which detects an output level at an output side of said second optical amplifier;

an output control unit which controls output lights of excitation light sources of said first optical amplifier and said second optical amplifier according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said second optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting the attenuation of an output signal light attenuated by said optical variable attenuator according to a gain inclination detected by said gain inclination detecting unit.

42. The optical amplifier apparatus according to claim 41, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave

and a longest wave.

43. The optical amplifier apparatus according to claim 41, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

44. The optical amplifier apparatus according to claim 41, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

45. The optical amplifier apparatus according to claim 41, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

46. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

a compensation light source which injects a compensation light that propagates in a forward direction of a propagation direction of the input signal light to said optical amplifier;

a first optical amplifier which amplifies the signal light;

an optical variable attenuator which attenuates an output signal light of said first optical amplifier;

a second optical amplifier which amplifies an output signal light of said optical variable attenuator;

a wavelength selecting unit which interrupts a compensation light at an output side of said second optical amplifier, and transmits only a signal light;

an output detecting unit which detects an output level of a signal light at an output side of said wavelength selecting unit;

an output control unit which controls the attenuation of an output signal light attenuated by said optical variable attenuator according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said second optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting an output light of said compensation light source according to a gain inclination detected by said gain inclination detecting unit.

47. The optical amplifier apparatus according to claim 46, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

48. The optical amplifier apparatus according to claim 46, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

49. The optical amplifier apparatus according to claim 46, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

50. The optical amplifier apparatus according to claim 46, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

51. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

a compensation light source which injects a compensation light that propagates in a forward direction of a propagation direction of the input signal light to said optical amplifier;

a first optical amplifier which amplifies the signal light;

an optical variable attenuator which attenuates an output signal light of said first optical amplifier;

a second optical amplifier which amplifies an output signal light of said optical variable attenuator;

a wavelength selecting unit which interrupts a compensation light at an output side of said second optical amplifier, and transmits only a signal light;

an output detecting unit which detects an output level of a signal light at an output side of said wavelength selecting unit;

an output control unit which controls an output light of said compensation light source according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said second optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting the attenuation of an output signal light attenuated by said optical variable attenuator according to a gain inclination detected by said gain inclination detecting unit.

52. The optical amplifier apparatus according to claim 51, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

53. The optical amplifier apparatus according to claim 51, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

54. The optical amplifier apparatus according to claim 51, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

55. The optical amplifier apparatus according to claim 51, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

56. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light;

a compensation light source which injects a compensation light that propagates in a forward direction of a propagation direction of the input signal light to said optical amplifier;

a first optical amplifier which amplifies the signal light;

a second optical amplifier which amplifies an output signal light of said first optical amplifier;

a wavelength selecting unit which interrupts a compensation light at an output side of said second optical amplifier, and transmits only a signal light;

an output detecting unit which detects an output level of a signal light at an output side of said wavelength selecting unit;

an output control unit which controls output lights of excitation light sources of said first optical amplifier and said second optical amplifier according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting an output light of said compensation light source according to a gain inclination detected by said gain inclination detecting unit.

57. The optical amplifier apparatus according to claim 56, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave

and a longest wave.

58. The optical amplifier apparatus according to claim 56, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

59. The optical amplifier apparatus according to claim 56, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

60. The optical amplifier apparatus according to claim 56, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.

61. An optical amplifier apparatus comprising:

an optical amplifier which amplifies an input wavelength-multiplexed signal light in an excitation light source;

a compensation light source which injects a compensation light that propagates in a forward direction of a propagation direction of the input signal light to said optical amplifier;

a first optical amplifier which amplifies the signal light;

a second optical amplifier which amplifies an output signal light of said first optical amplifier;

a wavelength selecting unit which interrupts a compensation light at an output side of said second optical amplifier, and transmits only a signal light;

an output detecting unit which detects an output level of a signal light at an output side of said wavelength selecting unit;

an output control unit which controls an output light of said compensation light source according to an output level detected by said output detecting unit;

a gain inclination detecting unit which detects a gain inclination of said second optical amplifier; and

a gain inclination control unit which controls a gain inclination by adjusting output lights of an excitation light

source of said first optical amplifier and an excitation light source of said second optical amplifier according to a gain inclination detected by said gain inclination detecting unit.

62. The optical amplifier apparatus according to claim 61, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of a shortest wave and a longest wave.

63. The optical amplifier apparatus according to claim 61, wherein said gain inclination detecting unit branches a wavelength-multiplexed signal light, and detects a gain inclination from optical signal levels of three or more waves.

64. The optical amplifier apparatus according to claim 61, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of a shortest wave and a longest wave respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals of respective wavelengths thereby to detect a gain inclination.

65. The optical amplifier apparatus according to claim 61, wherein said optical amplifier apparatus inputs a wavelength-multiplexed signal light having mutually different frequency components superimposed on optical signals of three or more waves respectively, and said gain inclination detecting unit detects frequency components superimposed on the optical signals thereby to detect a gain inclination.